

Third Quarter Project

Honors Precalculus

Instructions: Homework, quizzes, tests, and Supercorrections all provide opportunities for learning mathematics, but nothing beats a project for pulling it all together. Once again, this quarter we will all be working on the same project.

As before, you will be given some class time and some homework time to do your investigation and final write-up. You will use a spreadsheet as you investigate, and your project will be worked on in Google Docs.

Keep in mind that there may be no single correct answer to a question, and you will be evaluated on the basis of your reasoning, justification, and communication skills.

Effective communication of ideas is a very important component of mathematics.

The **rubric** for evaluation is on the back of this page. Your work will count as one of the two test grades for this unit.

Rather than using the sunrise and sunset tables for Grand Rapids, Michigan, we will use a table for your hometown. You can get this as well as a table for the days of the year on the class website.

To calculate the number of minutes for Table 2, you will use a spreadsheet. You enter the times with colons like this in cells A1 and B1:

7:10:00 16:05:00 (The last :00 are added automatically.)

Put the day number in cell C1. To calculate number of minute, you then enter this formula in cell D1:

=hour(B1-A1)*60+minute(B1-A1) (Do you see how this formula works?)

Complete Table 2 by filling down. You can use columns C and D to make your scatter plot.

A note on collaboration: You **may** discuss the content of this project with Mr. O'Brien, other students or anyone else but be sure to acknowledge any assistance received. Your final write-up must be your own- any copy and paste from the work of others is unacceptable.

Rough Draft Due: By midnight Saturday, March 21st

Final Draft Due: By midnight Saturday, March 28th

Name: _____

Project Rubric

Category	Poor	Fair	Good	Excellent
Presentation (10%) <ul style="list-style-type: none">• Is the paper neat?• Is the paper typed?• Is the paper done in an orderly manner?				
Mathematical precision and completeness (50%) <ul style="list-style-type: none">• Are the solutions complete?• Are the solutions correct?• Has there been a correct use of mathematical notation?				
Verbal explanations (30%) <ul style="list-style-type: none">• Are the explanations correct?• Are the explanations complete and precise?• Is there correct use of grammar and spelling?				
Graphs (10%) <ul style="list-style-type: none">• Are the graphs correct?• Are the graphs neat?• Are the axes labeled properly?				

General Comments:

Final Grade: _____

Days of Our Lives

The amount of daylight on a given day is an important part of our lives. As the seasons change, so does the amount of daylight. This change is greatest the further north you live (in the northern hemisphere). In the summer it is light until late in the evening, allowing plenty of time to go to the beach or play golf after dinner. In the winter, however, we often go to school in the dark and sometimes even come home in the dark. You have probably seen times for the sunrise and sunset in your local newspaper or given in a weather report on television. In this project you will derive a function which will give the amount of daylight in Grand Rapids, Michigan for any day throughout the year.

1. The times for sunrise and sunset are usually given in a table. In Tables 1(a) and 1(b) you are given the the times for sunrise and sunset in Grand Rapids, Michigan. We want a graph of the function where the day of the year is the input and the number of minutes of daylight is the output.

SUNRISE AND SUNSET AT GRAND RAPIDS, MICHIGAN (E.S.T.)

DAY	JAN.		FEB.		MAR.		APR.		MAY		JUNE	
	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.
1	8:14	5:19	7:58	5:55	7:19	6:32	6:25	7:09	5:37	7:43	5:07	8:14
2	8:14	5:20	7:57	5:57	7:17	6:33	6:24	7:10	5:36	7:44	5:06	8:15
3	8:14	5:21	7:56	5:58	7:16	6:34	6:22	7:11	5:34	7:45	5:06	8:16
4	8:14	5:22	7:55	5:59	7:14	6:35	6:20	7:12	5:33	7:46	5:05	8:17
5	8:14	5:23	7:53	6:01	7:13	6:37	6:18	7:13	5:32	7:48	5:05	8:17
6	8:14	5:24	7:52	6:02	7:11	6:38	6:17	7:14	5:30	7:49	5:05	8:18
7	8:14	5:25	7:51	6:03	7:09	6:39	6:15	7:15	5:29	7:50	5:04	8:19
8	8:13	5:26	7:50	6:05	7:07	6:40	6:13	7:17	5:28	7:51	5:04	8:19
9	8:13	5:27	7:49	6:06	7:06	6:42	6:12	7:18	5:27	7:52	5:04	8:20
10	8:13	5:28	7:47	6:07	7:04	6:43	6:10	7:19	5:26	7:53	5:04	8:21
11	8:13	5:29	7:46	6:09	7:02	6:44	6:08	7:20	5:24	7:54	5:03	8:21
12	8:12	5:30	7:45	6:10	7:01	6:45	6:07	7:21	5:23	7:55	5:03	8:22
13	8:12	5:31	7:43	6:11	6:59	6:46	6:05	7:22	5:22	7:56	5:03	8:22
14	8:12	5:32	7:42	6:13	6:57	6:48	6:03	7:24	5:21	7:57	5:03	8:23
15	8:11	5:34	7:41	6:14	6:55	6:49	6:02	7:25	5:20	7:59	5:03	8:23
16	8:11	5:35	7:39	6:15	6:54	6:50	6:00	7:26	5:19	8:00	5:03	8:23
17	8:10	5:36	7:38	6:16	6:52	6:51	5:58	7:27	5:18	8:01	5:03	8:24
18	8:10	5:37	7:36	6:18	6:50	6:52	5:57	7:28	5:17	8:02	5:03	8:24
19	8:09	5:38	7:35	6:19	6:48	6:53	5:55	7:29	5:16	8:03	5:03	8:24
20	8:08	5:40	7:33	6:20	6:47	6:55	5:54	7:30	5:15	8:04	5:04	8:25
21	8:08	5:41	7:32	6:22	6:45	6:56	5:52	7:32	5:14	8:05	5:04	8:25
22	8:07	5:42	7:30	6:23	6:43	6:57	5:50	7:33	5:13	8:06	5:04	8:25
23	8:06	5:43	7:29	6:24	6:41	6:58	5:49	7:34	5:13	8:07	5:04	8:25
24	8:05	5:45	7:27	6:25	6:39	6:59	5:47	7:35	5:12	8:08	5:04	8:25
25	8:05	5:46	7:26	6:27	6:38	7:00	5:46	7:36	5:11	8:08	5:05	8:25
26	8:04	5:47	7:24	6:28	6:36	7:02	5:44	7:37	5:10	8:09	5:05	8:25
27	8:03	5:49	7:22	6:29	6:34	7:03	5:43	7:38	5:10	8:10	5:06	8:25
28	8:02	5:50	7:21	6:30	6:32	7:04	5:41	7:40	5:09	8:11	5:06	8:25
29	8:01	5:51	7:20	6:31	6:31	7:05	5:40	7:41	5:08	8:12	5:06	8:25
30	8:00	5:53			6:29	7:06	5:39	7:42	5:08	8:13	5:07	8:25
31	7:59	5:54			6:27	7:07			5:07	8:14		

Table 1(a)

SUNRISE AND SUNSET AT GRAND RAPIDS, MICHIGAN (E.S.T.)³³

DAY	JULY		AUG.		SEPT.		OCT.		NOV.		DEC	
	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.	Rise A.M.	Set P.M.
1	5:07	8:25	5:33	8:04	6:07	7:18	6:40	6:25	7:17	5:35	7:54	5:10
2	5:08	8:25	5:34	8:03	6:08	7:16	6:41	6:23	7:18	5:34	7:55	5:09
3	5:08	8:25	5:35	8:02	6:09	7:14	6:42	6:21	7:19	5:33	7:56	5:09
4	5:09	8:25	5:36	8:00	6:10	7:13	6:43	6:19	7:20	5:32	7:57	5:09
5	5:10	8:24	5:37	7:59	6:11	7:11	6:44	6:18	7:22	5:30	7:58	5:09
6	5:10	8:24	5:39	7:58	6:12	7:09	6:45	6:16	7:23	5:29	7:59	5:08
7	5:11	8:24	5:40	7:56	6:13	7:07	6:46	6:14	7:24	5:28	8:00	5:08
8	5:12	8:23	5:41	7:55	6:14	7:06	6:47	6:12	7:26	5:27	8:01	5:08
9	5:12	8:23	5:42	7:54	6:15	7:04	6:49	6:11	7:27	5:26	8:02	5:08
10	5:13	8:22	5:43	7:52	6:16	7:02	6:50	6:09	7:28	5:25	8:03	5:08
11	5:14	8:22	5:44	7:51	6:18	7:00	6:51	6:07	7:29	5:24	8:03	5:08
12	5:15	8:21	5:45	7:50	6:19	6:59	6:52	6:06	7:31	5:23	8:04	5:08
13	5:15	8:21	5:46	7:48	6:20	6:57	6:53	6:04	7:32	5:22	8:05	5:09
14	5:16	8:20	5:47	7:47	6:21	6:55	6:54	6:02	7:33	5:21	8:06	5:09
15	5:17	8:20	5:48	7:45	6:22	6:53	6:56	6:01	7:34	5:20	8:07	5:09
16	5:18	8:19	5:49	7:44	6:23	6:51	6:57	5:59	7:36	5:19	8:07	5:09
17	5:19	8:18	5:50	7:42	6:24	6:50	6:58	5:57	7:37	5:18	8:08	5:10
18	5:20	8:17	5:52	7:41	6:25	6:48	6:59	5:56	7:38	5:17	8:09	5:10
19	5:21	8:17	5:53	7:39	6:26	6:46	7:00	5:54	7:40	5:16	8:09	5:10
20	5:21	8:16	5:54	7:38	6:27	6:44	7:02	5:53	7:41	5:15	8:10	5:11
21	5:22	8:15	5:55	7:36	6:28	6:42	7:03	5:51	7:42	5:15	8:10	5:11
22	5:23	8:14	5:56	7:34	6:30	6:41	7:04	5:50	7:43	5:14	8:11	5:12
23	5:24	8:13	5:57	7:33	6:31	6:39	7:05	5:48	7:44	5:13	8:11	5:12
24	5:25	8:12	5:58	7:31	6:32	6:37	7:07	5:47	7:46	5:13	8:12	5:13
25	5:26	8:11	5:59	7:30	6:33	6:35	7:08	5:45	7:47	5:12	8:12	5:13
26	5:27	8:10	6:00	7:28	6:34	6:33	7:09	5:44	7:48	5:12	8:12	5:14
27	5:28	8:09	6:01	7:26	6:35	6:32	7:10	5:42	7:49	5:11	8:13	5:15
28	5:29	8:08	6:02	7:25	6:36	6:30	7:12	5:41	7:50	5:11	8:13	5:15
29	5:30	8:07	6:03	7:23	6:37	6:28	7:13	5:39	7:51	5:10	8:13	5:16
30	5:31	8:06	6:05	7:21	6:38	6:26	7:14	5:38	7:53	5:10	8:14	5:17
31	5:32	8:05	6:06	7:20			7:15	5:37			8:14	5:18

Table 1(b)

³³The data in Tables 1(a) and 1(b) were provided courtesy of WZZM-TV channel 13, Grand Rapids, Michigan.

- (a) Complete Table 2 by giving the total amount of sunlight per day. You will have to convert from the date (month and day), used in Table 1, to the number in which the day occurs during the year, used in Table 2.

Day	Hrs	Min	Total Minutes
1	9	5	545
11			
21			
31			
41			
51			
61			
71			
81			
91			
101			
111			
121			
131			
141			
151			
161			
171			
181			

Day	Hrs	Min	Total Minutes
191			
201			
211			
221			
231			
241			
251			
261			
271			
281			
291			
301			
311			
321			
331			
341			
351			
361			

Table 2

- (b) Graph the points from Table 2 with the x -axis representing the day of the year (numbered 1 through 365) and the y -axis representing the number of minutes of daylight.
2. The entries in your table, as well as your graph, should correspond to your experience and knowledge of the seasons.
- (a) By examining your answers in Table 2, find the day with the most daylight and the day with the least daylight. Does this correspond with your experience and your knowledge of the seasons? Explain your answer.
- (b) By examining your graph from question 1(b) or your answers in Table 2, find the time of the year when the amount of daylight is changing most rapidly. When is it changing the least? How does this correspond with your experience and your knowledge of the seasons? Explain your answer.

3. Assume that this data can be represented by either a sine or cosine function.
- Why is it reasonable to use a sine or cosine function to represent this data?
 - What would be the amplitude of your function? What does this number mean in terms of minutes of daylight?
 - What would be the period of your function?
 - What would be the vertical shift of your function? What does this number mean in terms of minutes of daylight?
 - What is the phase shift of your function? What does this number mean in terms of number of days?
 - Write a function using either sine or cosine that would fit this graph.
4. We now will check the accuracy of your function.
- Complete Table 3. Use your function from question 3(f) to calculate the number of minutes of daylight expected on the given days. Use Table 1 to find the actual number of minutes of daylight. Compute the error between these two ($f(x)$ —Actual).

Date	Day	$f(x)$	Actual	Error
Jan. 1	1			
Feb. 10	41			
March 21	81			
April 30	121			
June 9	161			
July 19	201			
Aug. 28	241			
Oct. 7	281			
Nov. 16	321			
Dec. 26	361			

Table 3

- Looking at your results from Table 3, does your function give a good means of predicting the number of minutes of daylight on a given day? During what time of the year does it seem that your function is most accurate? During what time of the year does it seem to be least accurate? Explain your answers.